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THE special feature of this meeting is the discussion of the treatment of club-foot, but such discussion would be incomplete without some consideration given to the proper time for the first treatment to be instituted in order to be most efficacious. Notwithstanding the absence of any well-authenticated reason, and often in direct opposition to well-established facts, a vast number of cases still go on to maturity with uncorrected, relapsed, or only partially corrected feet. That this is due largely to misconception as to the proper time to begin treatment, as well as to apparent want of knowledge of what that treatment should consist, is clearly understood by all orthopedists.

The general practitioners, however, often advise delay, or they overlook the necessity for appropriate treatment early applied and persistently continued. As accoucheurs should often direct the first treat-

¹ Read before the American Orthopedic Association, September 20, 1892.



ment and decide as to the age at which it should be applied, it is important that they know the results of experience. In the table of cases reported by Dr. E. H. Bradford,¹ the age at which the cases were first seen by him is given as follows :

2 cases at	4 weeks	2 cases at	2½ years
I "	7 "	4 "	3 "
2 "	2 months	11 "	4 "
10 "	3 "	12 "	5 "
2 "	4 "	6 "	6 "
1 "	5 "	4 "	7 "
7 "	6 "	1 "	9½ "
1 "	7 "	1 "	10 "
3 "	8 "	3 "	11 "
6 "	1 year	2 "	12 "
2 "	1½ "	2 "	15 "
1 "	20 months	1 "	18 "
10 "	2 years		

The experience of others is similar to the above, and I have quoted Dr. Bradford instead of referring to my own case-book. An explanation of the delay, shown in the foregoing statement, may be found in the indefinite and often misleading statements of accepted text-books and writers on surgery, from a few of which I quote. Ashhurst² says: "Mechanical extension should be resorted to in the third to the fifth week, not before the third week. . . . The best age for tenotomy is between the second and third month." J. B. Roberts recommends³ "immediate correction by force, maintaining the position by gypsum bandage, and tenotomy after two

¹ Trans. Amer. Orthop. Assoc., 1889, vol. i, p. 89.

² Ashhurst: Prin. and Prac. of Surg., ed. 1885, p. 686.

³ Roberts: Modern Surgery, ed. 1890, p. 736.

months." Agnew¹ advises treatment "at an early period of life, but tenotomy not earlier than fourth or fifth month." Fisher² thinks that the most favorable time for tenotomy is when the child is six weeks old. Morton³ urges manipulation from early babyhood, but condemns tenotomy before the child is able to walk. A. S. Roberts⁴ states that "mechanical appliances should always be granted a fair trial before resorting to operation." Milliken⁵ considers that the best time to do tenotomy is when the child would begin to walk, but he advocates the institution of manipulation at birth. Prof. Sayre⁶ says "if prompt treatment were the rule, section of the tendons would rarely be called for, but should be resorted to when necessary." Gross:⁷ "Age is no bar to tenotomy." Druitt:⁸ "The earlier tenotomy is done after other treatment fails, the better." Ewens:⁹ "No educated surgeon of the present day would, I imagine, allow an infant to reach the age of three months without tenotomizing every contracted tendon or putting on suitable apparatus; but it becomes a serious question how far one would be justified in allowing a child to grow up beyond the age of three years when it is evident that the bony

¹ Agnew: Surgery.

² Fisher: Internat. Encycl. Surg., ed. 1888, vol. iii, p. 681.

³ T. G. Morton: Tr. Am. Surg. Assoc., 1890, vol. viii, p. 71, 72.

⁴ A. S. Roberts: Clinical Lect., Phila. Hosp., Nos. I and II, 1886.

⁵ Trans. Amer. Orthop. Assoc., 1890, vol. iii, p. 50.

⁶ L. A. Sayre: Trans. Ninth Internat. Congress.

⁷ S. D. Gross: System of Surg., ed. 1882, vol. ii, p. 1036.

⁸ Druitt: Modern Surg., ed. 1887, p. 491.

⁹ John Ewens: Brit. Med. Journ., Oct. 17, 1891.

deformity is so great as to defy rectification by free tenotomy." Bryant¹ recommends manipulation and strapping a few days after birth, and tenotomy when necessary. He has operated at one week. Stephen Smith² recommends treatment as soon after birth as possible. Wyeth says:³ "All forms should be treated from birth, and tenotomy determined by degrees of resistance." Moullin⁴ urges that treatment be begun in infancy and that tenotomy be performed if manipulation, etc., fail. Schrieber⁵ advises tenotomy as early as possible. Parker⁶ says: "It may be laid down as a canon that treatment should be commenced immediately after birth, and that tenotomy is an essential feature of the treatment of many cases." Pye⁷ says: "I believe that it will be found much speedier and a more satisfactory plan to recognize from the first that early tenotomy will give the best results." Bradford⁸ says: "Treatment should be begun as early in infancy as possible; the amount of time gained by tenotomy is not great." Vance⁹ begins treatment on about the tenth day by manipulation and retention apparatus and when that is not satisfactory divides the

¹ Bryant: *Prac. Surg.*, ed. 1884, p. 817.

² Stephen Smith: *Operative Surg.*, ed. 1887, p. 824.

³ Wyeth: *Text-book on Surg.*, ed. 1890, p. 811.

⁴ Moullin: *Treatise on Surg.*, ed. 1891, p. 355.

⁵ Schrieber: *Wood's Med. and Surg. Monographs*, vol. ii, No. 3, p. 807.

⁶ Parker: *Congen. Club-Foot*, ed. 1887, p. 85.

⁷ Pye: *Surg. Treat. Common Deformities of Children*, 1889.

⁸ Bradford: *Treat. Club-Foot*. *Trans. Amer. Orthop. Assoc.*, 1887, vol. i, p. 89.

⁹ Vance: *Discussion*, p. 115 *Trans. Amer. Orthop. Assoc.*, 1889, vol. i.

tendo Achillis. H. Hodgen¹ believes in the majority of cases in cutting the tendon and rectifying the deformity at once, not taking time to stretch the tendon. Steele² says of club-feet: "If they can be corrected without cutting, it would be far better." Keen and White³ say: "The earlier the deformity is corrected and the foot held in the right position, the better; time may be saved by tenotomy."

A plan of treatment appropriate to one case or class of cases is often inadequate in others, and therefore treatment when referred to in this paper will mean the thorough correction of the deformity, its proper maintenance, and the application of measures having for their object the full establishment of the functions of the foot. In whatever degree the deformity may exist, attempt should be made at the earliest possible moment after birth to correct the deformity. The first day is none too soon, in my opinion, and the longer the delay the more difficult will be the recovery. In no case should plaster of Paris or fixed and immovable apparatus be kept on for more than one month, for their continuance tends to produce muscular atrophy.

In all cases passive motion, gymnastic exercises, friction, and the encouragement of motion in proper directions should be early instituted and persistently maintained. In all cases the form of apparatus selected should make elastic, in preference to rigid, retention, to enable the patient voluntarily to move the foot in the proper direction, but upon

¹ Hodgen: *Ibid.*

² Steele: *Ibid.*

³ Keen and White: *Text-book of Surg.*, ed. 1892, p. 342.

the cessation of muscular effort to restore it to its normal position. In cases of the first degree, or in which the deformity is easily corrected and the correction is easily maintained, operative procedure in infancy is rarely, if ever, necessary. In cases of the second degree, or in which the deformity is corrected with difficulty, and in which considerable restraining force is required, it is often desirable to cut through an open wound every soft tissue that restrains complete restoration, rather than depend upon their possible stretching under force. The first day is none too soon to resort to such operative procedures, but any time during the first month will usually suffice. In cases of the third degree, or in which correction cannot be accomplished without the employment of great force, more extensive operative procedures are necessary, and should be resorted to only after failure of tenotomy. In some cases I believe that early removal of the astragalus will enable the patient to adjust the muscles to the new circumstances and assist in developing them. The earliest age at which this is proper is, in my estimation, between the ages of one and two years. In cases that have been without treatment in infancy, or that have relapsed, numerous operations have been recommended and resorted to, the consideration of which is inappropriate in this paper.

I contend that it is not rational to wait until the doubtful assistance of walking can be had, because I believe that it is clearly proved that the earliest moment at which the deformed foot is thoroughly corrected the more satisfactory will be the ultimate result. During the period of one year

or more spent in waiting for the child to walk the muscles will have adapted themselves in part to their abnormal positions ; some will have become inactive and others over-active. This ultimate result, however, depends upon the completeness of the first correction, and as well upon the efficiency of the maintenance of the corrected position and the establishment of a correlation of muscular forces.

Relapses are the inevitable result of inefficiency on the part of those having the care or direction of the institution of the first remedial measures employed, and one of the prominent factors in these cases I have found to be delayed early correction. While it is improper to say that in all cases operative procedure should be resorted to or refrained from, I firmly believe that the rule should be adopted, and without exception, that complete correction should be accomplished at the earliest possible moment—during the first month, if possible—and that this correction should be accomplished by the employment of every rational means, whether this be operative, mechanical, manipulative, or gymnastic ; but to be effective it must be complete.

I believe that the soft bones of the tarsus will alter their shapes as they are squeezed and compressed by force, and leave the shortened tendons as much contracted as they were before, because we know that, except by tearing, tendons rarely if ever yield, while cartilaginous bones, not yet ossified, will yield to pressure. I believe that on making an examination of many feet corrected without operation, but for which operations were indicated, no elongation of the tendons would be found, but an altered external

appearance of the foot due to the softened condition of the bones, squeezed into an external appearance of correction. At the earliest possible moment, therefore, we should employ any method that will be necessary to correct deformity and that will prevent a return to the deformed condition. The first correction, no matter by what means accomplished, is but the means to an end. It is not only correcting the appearance of the deformity, but it is the correction of the mechanical defect, so that the mechanical functions may be reestablished. The production of muscular atrophy, which is such a serious obstacle to the correction of club-feet after the period of infancy has passed, is a profoundly interesting subject, and I have but to refer to Chinese ladies' feet for evidence of what is too often done with club-feet.

The long-continued use of mechanical correction or restraining apparatus of any kind that does not provide for free ankle-motion will accomplish a muscle-atrophy just as successfully as the foot-binder. This muscle-atrophy is in turn followed by atrophy of the bones, not only in their diameter but also in their length. The natural tendency of a congenital club-foot is toward atrophy (from disuse) and increased deformity, and to avoid these we are, therefore, warranted in resorting to every means. The certainty with which, by judicious means, muscle-atrophy is corrected clearly indicates that if in congenital club-feet it cannot be entirely prevented, it can at least be arrested and controlled.

The length of time required to accomplish a full and complete correction of a congenital club foot is

the same as that required to form the foot of a normal child, and depends upon the age at which correction was obtained and the efficiency of the remedial measures employed. Not until the normally formed child is ten or twelve years old does the foot possess the normal mechanical conditions necessary for its full usefulness. All babies are flat-footed, many are naturally pigeon-toed, but all these conditions pass off so soon as the correlation of muscular forces establishes the mechanical functions. The same may be said of a child born with a club-foot, certainly in the milder forms: that until the age of ten or twelve years the correction must be maintained mechanically, and efforts must constantly be made to develop the muscular system; the longer the delay in establishing the normal functions the less likely will those functions be normal.

That which in the normal child prevents the foot from becoming deformed, although it may be placed temporarily in a deformed position, is the correlation of muscular forces, and this can and must be established in cases of club-foot that are corrected sufficiently early. The absurdity must be avoided of resorting to gymnastic forms of treatment, and at the same time destroying their efficiency by the use of mechanical restraining apparatus that not only prevents the reproduction of the deformity but at the same time restrains all motion. Thus I have seen rigid plaster-of-Paris and rigid steel braces in constant use in a case in which it was removed for half an hour every day, and during that time developmental methods were employed. The trivial gain by manipulation was irrevocably

lost by the employment of an apparatus that kept every part of the foot immovable.

To accomplish a complete recovery there must be an understanding of the mechanical functions to be recovered; this is apparently wanting in those who postpone the application of rational treatment, or who simply cut tendons and allow the case to relapse by neglect, or who consider braces to be curative. The diversity of views as to the existence of bone-malformation will in part account for the existing differences of opinions as to the propriety of resorting to operative procedures early in infancy. Druitt¹ believes that in some cases the astragalus is quite normal, proving that bone-changes are not necessary to talipes. Erichsen² says that very little alteration has taken place in the condition of the bones. Power³ states: "I am, therefore, led to suppose that the deformity is due entirely to bone-changes." Ashhurst⁴ says: "In most cases bones of the foot are not altered in structure." Adams⁵ maintains that in cases of varus the astragalus is malformed from the moment of birth. Morton⁶ says: "Bones, especially the astragalus, are greatly deformed and unrecognizable after excision." Phelps⁷ states: "Deformity of soft parts out of all proportion to the deformity of bone."

¹ Druitt: *Modern Surgery*, edition of 1887, p. 491.

² Erichsen: *Science and Art of Surgery*, ed. of 1884, p. 579.

³ Power, Arcey: *Trans. Path. Society, London*, 1888 and 1889, xl, p. 248.

⁴ Ashhurst: *Principles and Practice of Surgery*, ed. of 1885, p. 686.

⁵ Adams: *Amer. Surg. Association*, 1860, viii, p. 71.

⁶ *Trans. Amer. Surg. Association*, 1890, vol. vii.

⁷ *New England Medical Monthly*, February, 1891.

I am convinced that to a very large extent the changes in the structure of the bones often described are in large measure due to postponement of appropriate treatment. This may be accounted for in either of two ways: First, that observed in uncorrected cases in which the process of ossification progresses and the partially dislocated tarsal bones become permanently deformed to suit the abnormal position of the foot; and, secondly, in those cases of more or less marked severity where, to stretch shortened tendons, there has been recourse to mechanical force. In these cases the bones, whether deformed or not, yield to the pressure exerted and thereby become deformed, and ossify in their altered shape. In most instances both of these occurrences could and should have been avoided by the early recourse to operative procedures. It is not a question of saving time, but of perfect correction.

In conclusion, I would offer the following:

That full, perfect correction should be obtained during the first month.

That if correction is possible without recourse to rigid restraining apparatus, tenotomy should be avoided.

That when perfect correction cannot otherwise be maintained without employing undue force, tenotomy, syndesmotomy, or cutting of fascia, should always be resorted to in the first month.

That in infancy tenotomy should never be resorted to without being followed by developmental as well as restraining treatment.

That it is misapplied mechanics to force a club-

foot into a rigid restraining-shoe, and that doing so in the first months of infancy will produce ultimate bone-deformity.

That all apparatus employed in infancy should facilitate free motion in the proper—*i. e.*, normal—direction, and encourage the development of a correlation of muscular force.

All methods that employ undue force in correcting or restraining club-foot should be abstained from until the child reaches the age when the bones are completely ossified. The same period should be awaited before resorting to operations upon the bones.

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